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Transport on Demand in the Opinion of Users: A Case Study for Poland[1]

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Abstract:

Purpose: *The aim of the article is to review the literature in terms of cross-sections of the assessment of the functioning of transport on-demand (ToD) and to present one's own views in this area, based on the research results.*
Design/Methodology/Approach: *The basis for the assessment was a study conducted by the author among ToD passengers in Szczecin (Poland). In the literature a synthetic assessment of transportation on demand is undertaken much more often. It concerns more the supply side of the market, while the demand side is affected less frequently. Hence, it appears to be well-founded and valuable, both in epistemic terms, to present the assessment of transportation on demand in terms of demand, which is referred to in this article.*
Transport–on-demand comprises a precious completion of public transport and an alternative for individual motorization. The offer is dedicated for areas where there is a low and/or volatile demand for transport-services.
Findings: *The presented research results on the opinions of users of the transportation-on-demand service in Szczecin confirmed that it is primarily used by frequent transportation users. This is also reflected in the most frequently chosen travel destinations, which includes commuting to places of learning and workplaces. Among the various cross-sections of the analysis, it is also worth paying attention to the opinion of young people using the transport on demand service. Their responses show greater concern for the condition of the natural environment and the need for faster teleinformation changes related to the ToD service.*
Practical Implications: *They can be used to improve the management system of ToD.*
Originality value: ***T****he literature presents no research related to this subject concerning Poland. This article may fill the knowledge gap in the assessment of transportation on demand. In Poland, this research is pioneering.*

Keywords: *Flexible transport systems, demand, user ratings.*

JEL codes: *R 410.*

Paper type: *Case study.*

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1. Introduction

In the light of contemporary challenges such as sustainable development, climate neutrality or progressive population ageing, ensuring the right level of availability of public services is becoming a major social and economic issue. There are different areas characterized by a limited or a lack of access to urban transport services. This is essentially because of the low demand for transportation, which is a follow-up to the low population around a certain location. Such places include marginal areas of cities or villages.

Improving accessibility of transportation is possible by the development of transportation-on-demand services. They can represent a precious completion of public transportation and an alternative to individual motorization and can guarantee the expected frequency and scope of the service offering. This type of service is used in many highly developed countries, especially in Western Europe and the USA. However, as reported by the literature, there is no uniform format for the functioning and development of transportation on demand, as well as its evaluation.

One possible answer to assessment of the functioning and development of transportation on demand is the opinion of people using this system. The author is not aware of studies on the evaluation of the functioning of transportation on demand by transport users. This approach can be considered valuable both on scientific and practical grounds.

2. Literature Review

Transport-on-demand services are a new approach to ensuring the mobility of residents. They are characterized by flexibility in relation to their provision. Hence, the literature contains different terms characterizing such a way of providing services (flexible transport systems, transport on demand, demand-responsive transport).

The flexibility of the supply of transportation concerns the routing, the time of implementation, the method of payment and the characteristics of passengers (e.g. transport dedicated to the elderly, disabled). In seeking to determine the place of transportation on demand in the public transport system, it can be indicated that they occupy a place between regular transport and taxi services.

In literature, the assessment of the functioning of flexible transport systems is an underdeveloped issue. Analysis of the available scientific studies shows that it focuses on the following aspects: economic and managerial. In the economic territory, the assessment of transportation on demand is related to the analysis of benefits and costs of operation (CBA method), cost-effectiveness (CEA method), multi-criteria (MCA method), demand for transport on demand (Brake, Nelson, and Wright, 2004; Nelson, Wright, Masson, Ambrosino, and Naniopoulos, 2010; Daniels

and Mulley, 2012) and comparative analysis (Daganzo, 2010; Nourbakhsh and Ouyang, 2012; Badia, Estrada and Robusté, 2014). From the managerial perspective, problems related to optimization of the functioning of the flexible system are raised, including the planning of vehicle or passenger journeys (Häme, 2011; Horn, 2004; Carballedo, Osaba, Fernández, and Perallos, 2011).

Within the abovementioned areas, the authors shall assess flexible transport systems, most often considering one aspect of analysis. Most studies concern the operation and development of transportation on demand. Discussed are also issues of price formation in flexible transport systems (Emele, Oren, Zeng, Wright, Velaga, Nelson, Norman, and Farrington, 2013), operating costs (Lee and Savelsbergh, 2017; Ronald, Thompson, and Winter, 2015), the impact of flexible transport systems on the mobility of inhabitants of suburban areas (Khaled, 2015; Velaga, Rotstein, and Nelson, 2012), analysis of deciding factors for the selection of flexible transport systems by inhabitants of suburban areas (Wang, Quddus, Enoch, Ryley, and Davison, 2015), the impact of flexible transport systems on the sustainable development of public transport, the obligation to ensure accessibility of public transport (Saroli, 2015), conditions for implementing flexible transport systems (Takeuchi, Fujita, and Otake, 2010), and barriers related to the implementation of flexible transport systems (Mulley, Nelson, Teal, Wright, and Daniels, 2012).

Papanikolaou *et al.* (2017) presents a broader approach to assessing the performance of transportation on demand. According to the authors, it should include the definition of the geographical area of the system's operation, the type of flexible system, the methodology of system evaluation and measures of its effectiveness. Assessment can be carried out for two cases comparative between regular and non-scheduled transport, which allows choosing the method of handling the transport needs of residents or an analysis related to the introduction of a new service in areas previously without access to public transport. In the former case, the analysis correlates to low demand for transportation services prompting the transport operator to replace regular transport with flexible transport. This allows for maintaining access to public transport.

Although methods of assessing the functioning of flexible transport systems have been developed, the literature emphasizes that a great difficulty in designing and assessing transportation on demand still exists. This is essentially because of the complexity and specificity of local transportation systems whose nature is institutional (policy, regulation, domestic legislation), economic (sources of financing, taxes, costs for the user) and organizational (selection of the transport organizer). Educational and information campaigns are important for the development of flexible systems (Mulley, Nelson, Teal, Wright, and Daniels, 2012). Hence, it is difficult to produce a model for a strategy to develop flexible transport systems that would be useful for decision-makers in the development of public transportation in various countries. The lack of harmonized solutions for the assessment of flexible transport systems is also visible in terms of their geographical

coverage. Studies are to be regarded as good practices at regional or national level (Logan, 2007).

The need for ongoing research in the development of the evaluation of flexible transport systems should be underlined. This is notably because of the residents' expectations as to the level of accessibility to public services, also in suburban areas. Maintaining regular transport is often irrational from the economic and environmental point of view. Hence, transport operators should take into account the provision of an adequate level of public services when looking for or developing new, innovative forms of transport. This condition will be met by on-demand transportation, which may take various forms. The decision to implement flexible transport systems should take into account the following levels: strategic (long term networks and transit routes design), tactical (frequencies of service along the routes and the timetable) and operational (bus route planning, vehicle scheduling, driver scheduling, bus parking and dispatching in garages, and maintenance scheduling) (Papanikolaou *et al.*, 2017).

A major direction in the development of the analysis of flexible forms of transport, and assessment of their functioning and development may be carried out taking into account the preferences of transport users. This issue is addressed by the article, especially on a practical level.

That said, in the literature a synthetic assessment of transportation on demand is undertaken much more often. It concerns more the supply side of the market, while the demand side is affected less frequently. Hence, it appears to be well-founded and valuable, both in epistemic terms, to present the assessment of transportation on demand in terms of demand, which is referred to in this article. Moreover, the literature presents no research related to this subject concerning Poland. This article may fill the knowledge gap in the assessment of transportation on demand.

3. The Essence of Transport on Demand

The hitherto practice used in the analysis of the functioning of flexible transport systems allows for the identification of its features. The main ones include:

A. Irregularity in the provision of transportation. It is related to the time and space of providing transportation services. These two parameters enable to distinguish two basic types of transportation on demand linear and area related. The linear system is included in the timetable however, it is activated as required. Its distinguishing feature is moving along a predetermined communication line and stopping only at communication stops reported by passengers. This system can also have a hybrid character, i.e., some of the courses on a given line are operated systematically (most often school and employee transport), while others are provided only on request, most often at lunchtime, at noon. The operation time of flexible systems trends to be limited to working days. Flexibility may also apply to

the duration of the provision of transport services. For example, at Christmas time, periods of holidays, some courses carried out on a regular basis are changed into irregular mode. The irregularity of flexible transport may also concern the spatial configuration.

This method of organization is associated with the area-related system of flexible transport, which is characterized by the lack of designated communication routes. The driving route of the means of transport is determined by a special software (algorithm) or individually by the dispatcher of the flexible transport system who is in contact with the driver. In this system, it is important to designate a transport point to which passengers from a given territory are transported by the shortest route. Continuing their journey, passengers can use regular transport based on an already purchased ticket, thus meeting their needs.

B. The need for an individual request for transport (e.g. by phone) by transport users. It is an important and, at the same time, expensive component of the management of transportation on demand (the so-called arrangement of record) which, using appropriate software, has the following functions: managing the means of transport, determining the route (in the case of an area-related system), collecting information about the demand for journeys, etc. Another type of cost, which to some extent also occurs with regular services, is the so-called service readiness of the means of transport, which includes the driver's wages and maintenance of the means of transport in reserve.

C. Implementation of multiple functions of a social, economic, and environmental character**.** In social terms, ensuring the handling of transportation needs based on public services offers the opportunity to reduce the sense of social exclusion among residents. In economic terms, issues related to the profitability of the flexible transport system are important. While profit is not the purpose of flexible transport services, the shared use of transport modes is cheaper than the use of individual transport for travel. Furthermore, public transportation, including flexible transport, should be seen as a public good which, in principle, requires subsidizing.[3] It should furthermore be underlined that the cost of flexibly providing transport services is lower than those provided in a regular manner, which reduces the overall costs related to the level of their funding by public authorities. Achieving the environmental effect is possible by the shared use of means of transport.

[3] *An example is public transport which, as a result of subsidies, increases its competitiveness in relation to individual motorization. It allows reducing the fulfillment of transport needs with individual motorization and external costs of mobility. The premise for their co-financing is social policy which most often takes into account the need to protect the disadvantaged who, due to lower income, may have limited access to some goods that are produced on market terms. The notion of public good in the field of economy was formulated by P.A. Samuelson. See P. A. Samuelson, 1954, The Pure Theory of Public Expenditure, „Review of Economics and Statistics", vol. 36, no. 4, p. 387–389.*

D. Improvement of transport accessibility in areas with low and/or fragmented demand for transport service (Mageean and Nelson, 2003). Flexible transport systems are one of the applied solutions to the problem of limited (or the lack of) accessibility of passenger transport in areas with low demand for transport services (Mulley and Nelson, 2009) Moreover, like regular public transport, they are an important alternative for individual motorization (Velaga, Nelson, Wright, and Farrington, 2012).

4. Assessment of the Functioning of Transport on Demand in Szczecin

Questionnaire examination was carried out among passengers of transportation on demand in Szczecin in November 2019. The PAPI method was used for this purpose. At the time of the research, transportation on demand was used by a total of 763 passengers, including 369 children (48%) and 394 people 16 years and more (52%). The study, in line with legal requirements, was conducted only on the latter group of people. Two hundred passengers were tested, which means that over 50% were analyzed.

The questionnaire form consisted of 10 issues related to the assessment of the functioning and development of transportation on demand in Szczecin, which concerned means of satisfying the transport needs by residents before launching transportation on demand in Szczecin, the consequences of the lack of access to public transportation, the use of transportation on demand, the frequency of using transportation on demand, the conditions for selecting transportation on demand, quality of transportation on demand, information availability of the transportation on demand booking system, layout of stops for transportation on demand and directions of development of the transportation-on-demand service.

4.1 Addressing Transportation Needs before the Emergence of the Transportation-on-Demand Service

Before the emergence of transportation on demand, passengers most often travelled using regular public transport (60%), neighboring assistance (32%) or used the services of taxi corporations (8%). Retirees and disability pensioners are the only social group that, prior to the emergence of transportation on demand, uses neighboring assistance for transport most often. This trend may follow from good relations with neighbors, which may be attributable to a long common period of inhabiting a given area. On the other hand, students (pupils), as well as employed and unemployed people, often chose the nearest public transport stops to ensure their mobility. In the submitted responses, the relatively frequent use of taxi services by unemployed people is pointed, but also, which may indicate weak people-to-people links of this social group, the lack of using neighboring assistance in transport for various purposes.

4.2 Consequences of the Lack of Access to Regular Public Transport Services

The lack of access to regular public transport affects the attainability of various destinations by residents. According to the research results, the lack of access to transportation on demand made it more difficult for residents to commute to work. Such shortcomings were indicated by approx. 50% of the respondents, who believe that access to friends (42%) and shops (47%) was also hindered. Fewer people indicated problems resulting from the lack of access to regular public transport related to commuting to places of learning (35%). On the other hand, the lack of access to public transport did not constitute a significant impediment in commuting to cultural sites (8%) and health centers (16%).

According to the results of the research, gender influences the assessment of the inability to reach selected travel destinations. The lack of public transport was more cumbersome for women. Apart from commuting, it also hindered reaching commercial establishments and friends, while men referred to problems related to travel to places of learning and, similarly to women, to friends. Considering social status working persons experienced problems with commuting to the workplace, commercial establishments and friends, while unemployed people to health centers and commercial establishments. On the other hand, for students (pupils), the lack of sustainable transport made it difficult to reach places of learning and friends. For retirees and disability pensioners, commuting to health care and trade venues was a problem.

4.3 Use of the Transportation-on-Demand Service

Passengers most often use transportation on demand for commuting to work, places of learning and commercial establishments. Less frequently, this form of transport is used to travel to cultural sites, health centers or friends.

Men more often use transportation on demand for commuting to work, places of learning, cultural sites and for friend visits, while women travel to health centers and commercial establishments. Social status influences the choice of destination of passengers for transportation on demand. Students (pupils) use transportation on demand to travel to places of learning and their friends. Working people commute mainly to work and shopping, while unemployed people for shopping and health purposes. Retirees and disability pensioners use the service mainly for shopping and to travel to health centers.

4.4 Frequency of Using Transportation-on-Demand Service

Over half of the respondents (53%) use transportation on demand every day, while about 1/3 use it several times a month. Men use on-demand transport more frequently in their daily journeys, which is influenced by their most preferred destination - work.

Considering the social status of transport users, in everyday travel students (pupils) most often use transportation on demand. On the other hand, pensioners and disability pensioners as well as unemployed persons use transportation on demand less frequently. This is linked to the nature of the needs satisfied by the inhabitants. Younger people (pupils and students) as well as working persons choose the service mainly due to the need to travel to places of learning and work. Those requirements are characterized by the need for daily journeys. Older people, for whom commuting to shops and health centers are the most important, use transportation on demand less often.

4.5 Rationale behind the Selection of Transportation-on-Demand Service

The main premise for choosing transportation on demand in Szczecin is the cheapness of the service, which is important for about 60% of the surveyed passengers. It should be emphasized that the system of regular transports and transportation on demand in Szczecin is integrated. This means that based on one ticket, both single-ride and monthly, passengers can use both types of services. With the time tariff, which is available in Szczecin, it is particularly favorable for holders of monthly tickets. About 40% of the surveyed passengers choose this type of service due to the lack of their own means of transport or the lack of authorization to use it. According to the research results, considerably less important rationales for choosing transportation on demand are concerns for the natural environment, difficulty in driving a passenger car or problems with parking a car in the city.

Gender has no significant impact on the choice of transportation on demand. It can only be noted that the cheapness as well as difficulties arising from using a passenger car in the city are marginally more important when choosing transportation on demand for men. On the other hand, women choose transportation on demand more often due to the lack of a passenger car and care for the natural environment.

That said, greater disparity in the responses related to preferences of transport customers can be seen taking into account the social status of the analyzed respondents. When selecting transportation on demand, the price of transportation services is the most important single selection criterion for younger people represented by students and pupils. In any case it has, however, to be noted that there are certain limitations in this group of people. This will include less opportunity to use a car for transport (a driving license can be obtained in Poland at the age of 18) or lower financial resources compared to other social groups. This social group often remains under the care of parents and most often has limited financial resources while learning. Moreover, it is a group of people who exercise privileges in public transport (e.g. the possibility of purchasing discount tickets).

More often than other groups, working people indicated that they choose transportation on demand due to problems with travel with their own passenger cars.

This social group also indicated that they choose the service due to difficulty in finding parking places for their own passenger cars. As the most important rationale for choosing transportation on demand, the oldest people considered the lack of their own car or the inability to use it, which may be due to the health condition of this social group.

4.6 Information Availability of the Transportation-on-Demand Service

The level of information on transportation on demand in Szczecin was highly ranked by passengers. For approx. 60%, it is very good and over 30% see it as sufficient. Only 8% of passengers considered the current information system to be insufficient.

Taking into account gender, men assessed the information system slightly better. Greater disparity in the assessment of the information system can be noticed considering the social status of respondents. In general, along with the increase of age, the percentage of responses positively assessing the level of information about transportation on demand increases. The dominant answer among pupils and students was that the level of information is sufficient. This may be influenced by the fact that this social group eagerly uses technical advancements also in the field of access to information. This was reflected in the further part of the study devoted to the directions of development of transportation on demand in Szczecin. In other social groups, it is rated as good. For older people who use modern ICT solutions less frequently, basic information related to transportation on demand is sufficient.

4.7 Reservation System for Transportation-on-Demand Service

More than half of the respondents indicated that the presently operating system of booking transportation on demand does not require changes. Nearly 25% considered the too long time associated with ordering transport on demand as a drawback. About 10% of respondents indicated too long waiting time for a connection and an earlier need to book transportation on demand.

Although men are a group that does not see any need to change the current system more often, this group also sees the need to develop the booking system, e.g. with the possibility of ordering through a special application or by e-mail. On the other hand, women more often indicate the need for changes in the reservation system, pointing to a drawback related to the long waiting time for a connection and the need to book the service well in advance.

Taking into account social status, most comments to the currently operating system in the field of booking are reported by pupils and students, which is correlated with the responses of young people presented above. A too long waiting time is a disadvantage in the current system for unemployed people, while the need to book transportation on demand well in advance is a drawback for working people, retirees and pensioners as well as pupils and students.

4.8 Layout of Stops for Transportation-on-Demand Service

A decisive majority of respondents (76%) considered that the current location of stops does not require changes. The need for correction consisting in the introduction of new stops was indicated by approx. 1/5 of the respondents. About 4% indicated the need to correct the currently existing routes.

The gender of the respondents has no influence on the share of responses in terms of assessment of the layout of stops or route alignment. On the other hand, taking into account age, the need to create new stops would be expected mainly by professionally active people who frequently use the services.

4.9 Directions of Development of Transportation-on-Demand Service

In the study, the respondents were asked to comment on the necessary adaptations for further development of the transportation-on-demand service in Szczecin. The survey included three areas of changes desired by passengers: system operation time, new ways of ordering courses and improving the connection of the transportation-on-demand service with other means of public transport.

A. Extending the system operation time

About 40% of respondents indicated the need to extend the system operation time. According to the respondents, it should mainly concern working days, which was indicated by 37% of respondents. Considerably less people see the need to extend the system operation time by public holidays, and it must be added that the system works only on working days.

Considering gender, as a group, men often indicated the need to extend the system operation time, including on working days. However, taking into account social status, working people are the social group that most often indicated the need to extend the system operation time. The results in the other groups are similar. One might wonder about the low share of answers related to the time development of the system among younger people. This group is considered to be the most active in life, especially during days off work, and willing to meet with their peers. There are known examples from countries of Western European of creating dedicated on-demand services which, apart from ensuring mobility, are also concerned with the safety of the youngest citizens (e.g. Nightraider in Luxembourg).[4]

B. New ways of ordering courses

[4]*For more information see Kwarciński T., Theoretical and pragmatic aspects of functioning of flexible transport systems, European Journal of Service Management, Szczecin, 2018, no. 4 (vol 20/1), pp. 159-164.*

The need to introduce new ways of ordering courses was indicated by approximately 40% of respondents. More modern ways of ordering courses are more important for men than for women. There is a visible convergence in the answers when analyzing age and social status. New innovative ways of ordering services (e.g. smartphone application) are more important for younger and working people, while there is no interest in new means of ordering among retirees and the unemployed.

C. Development of the transportation-on-demand system by allowing direct access to selected destinations

In assessing the possibility of developing the transportation-on-demand service, the respondents were offered selected travel destinations. Among the specified destinations, the respondents most often chose the need for better communication with regular transport stations as well as the possibility of creating direct journeys to entertainment spots or health centers. While the majority of respondents pointed to the need to develop a system consisting in better communication with regular transport stops, the need for development consisting in creating direct connections to places of entertainment was expressed by younger people and for health care – by older people.

5. Conclusions and Recommendations

Transportation on demand constitutes a precious completion to public transport. Its positive nature is linked above all to the improvement of transport accessibility for residents who are unable to use regular public transport services. The literature contains different ways of evaluating the transportation-on-demand service. The presented assessment methodology, taking into account the survey, can be treated as a supplement to the existing research in this field. The presented research results on the opinions of users of the transportation-on-demand service in Szczecin confirmed that it is primarily used by frequent transportation users. This is also reflected in the most frequently chosen travel destinations, which includes commuting to places of learning and workplaces.

Therefore, further research should be undertaken to validate the introduction of, for example, hybrid solutions. This would take into account the arrangements at selected times of connections launched based on the timetable. On the other hand, at times characterized by lower attendance (noon and evening), transportation on demand would be carried out on the basis of the present rules. Taking into account the above assumption, it could also be valuable to introduce transport services as a pilot exercise (for a trial period, e.g. 1 month).

This solution is supported by the fact that working people and children under 16 (although they were not included in the survey) constitute a large share of passengers. Those are groups of people whose needs (work, study) are obligatory; they are characterized by specific times of occurrence, making them more

predictable. This makes it easier to fulfill them on the basis of regular public transport.

The transition to a hybrid system should take into account the combination of regular and non-scheduled transport. This is important because the majority of people who use non-scheduled transport are the existing customers of public transport, which is evidenced by the information that they used the nearest active stops, and reached them in various ways, in their mobility.

Beside improving accessibility to public transport, the positive impact of transportation on demand on travel safety and environmental protection is also important. Unfortunately, only younger passengers paid attention to this aspect. This may be attributable to global trends where younger people in particular show greater concern for their future. The transportation-on-demand service also reflects the care, in this case of the city, for its inhabitants.

It is important, especially for the younger generation, to introduce modern ICT solutions. Their implementation should contribute to the improvement of the currently functioning non-scheduled transport system in various time aspects (e.g. booking); such a need was indicated by respondents. This should improve the functioning of the system in terms of waiting for a connection or ordering the service in advance.

The comparison between difficult travel destinations due to the lack of access to regular public transport and the actual use of transportation on demand by passengers demonstrates that the discrepancy in this respect is insignificant. Only in the case of women can it be said that it is greater, as it was indicated by this group that the lack of access to public transport makes it the most challenging to commute to work. Meanwhile, women most often use transportation on demand for travel for shopping No such differences were noticed in the remaining groups.

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